Monitoring Hybrid Cloud Applications in VMware vCloud® Air™

VMware vCenter™ Hyperic® and VMware vCenter Operations Manager™ Installation and Administration Guide for Hybrid Cloud Monitoring

TECHNICAL WHITE PAPER

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## Revision History

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Overview

IT organizations are increasingly deploying and managing multicloud architectures in which they use both their own virtualized private cloud as well as cloud infrastructures hosted by other cloud providers, such as VMware vCloud® Air™. Users reap the benefits of choice, flexibility, agility, and the ability to run workloads at will and without compromise.

There are several challenges associated with monitoring and managing these types of deployments. These include the lack of visibility for hybrid workloads, the need for a consolidated view for all workloads running both on and off premises, and the ease of managing these diverse and potentially geographically dispersed deployments.

This document is intended to provide IT professionals with the necessary information to monitor and manage the performance of applications and workloads running in a hybrid cloud environment using VMware vCenter™ Hyperic® and VMware vCenter Operations Manager™.

This white paper describes the use of these cloud management tools on applications running within vCloud Air.

High-Level Solution

In this VMware hybrid cloud-monitoring solution, a vCenter Operations Manager instance is assumed to be already running on premises, managing and monitoring local servers and applications. A vCenter Hyperic server and agent(s) are deployed in vCloud Air to collect server- and application-related data.

The monitoring data is then sent from the vCenter Hyperic agents to the vCenter Hyperic server. Then, leveraging the vCenter Operations Management Pack for vCenter Hyperic, data is centrally collected to the on-premises vCenter Operations Manager instance.

The following are the key benefits of using this architecture that leverages vCenter Operations Manager and vCenter Hyperic to monitor workloads running across hybrid clouds:

• Provides a consolidated view of both on-premises and cloud workloads
• Isolates and resolves performance bottlenecks rapidly by leveraging vCenter Operations Manager and vCenter Hyperic capabilities that are currently in use by the customer
• Quickly identifies the locations of both on- and off-premises workloads
• Effects cost reductions due to the lack of need for a second operations team to manage cloud infrastructure and applications
NOTE: Data is sent unidirectionally from the vCenter Hyperic agent to the vCenter Hyperic server. The vCenter Hyperic management pack requires bidirectional communication between the vCenter Hyperic server and the on-premises vCenter Operations Manager server.

Solution Deployment Options Considered

The following two deployment options were explored for leveraging vCenter Hyperic to monitor the workloads running in the cloud:

Option 1 - The vCenter Hyperic server and vCenter Hyperic agents are deployed in the cloud to monitor the workloads. The data is sent unidirectionally from the agents to a vCenter Hyperic server and then from the vCenter Hyperic server across a WAN to the on-premises vCenter Operations Manager server instance.

Option 2 - Only vCenter Hyperic agents are deployed in the cloud to monitor the workloads. The data is sent unidirectionally across a WAN from the agents to an on-premises vCenter Hyperic server and then to the on-premises vCenter Operations Manager server.

Although the two options use the same tools and provide identical monitoring coverage for hybrid cloud environments, Option 1 is the preferred and outlined deployment choice.

Option 1 was selected for the following reasons:

• It enables data collection in vCenter Hyperic even if the connection to the customer data center is down.
• It requires a single source–destination IP pair and therefore fewer firewall rules to manage.
• Any future infrastructure changes on premises require far fewer modifications in the hosted cloud environment because there is a single direct connection from the vCenter Hyperic server to the on-premises vCenter Operations Manager instance.
• Consolidation of data collection traffic between the vCenter Hyperic server and the vCenter Operations Manager instance is generally more efficient than multiple vCenter Hyperic agents’ communicating individually to a vCenter Hyperic server across a WAN.

The potential downside of Option 1 is the installation and maintenance overhead for the vCenter Hyperic server in vCloud Air in addition to the instance that is likely running on premises. In aggregate, however, the previously listed benefits outweigh any potential downside, and Option 1 is the preferred and outlined deployment choice.
vCenter Operations Manager Configuration on Premises

vCenter Operations Manager Deployment Requirements
This section describes the required network and firewall changes to enable communication between the on-premises vCenter Operations Manager server and the vCenter Hyperic server running in vCloud Air.

- A public IP address is required on the on-premises vCenter Operations Manager corporate network for posting data back to the vCenter Operations Manager UI virtual machine. An HTTP post adapter resides on the UI virtual machine.
- NAT and firewall rules are required for outbound and inbound posting of data to vCenter Operations Manager. All data is sent over HTTPS:443. See the following “NAT Rules” and “Firewall Rules” sections.

NAT Rules
In a typical enterprise network environment, NAT rules are required to enable proper communication between resources behind the firewall. These changes must be made on the vCloud Air edge gateway, and subsequent rules are needed on the customers’ on-premises environment.

Tables 1 and 2 details the NAT rules required to permit proper communication between vCloud Air and on-premises vCenter Operations Manager deployments.

<table>
<thead>
<tr>
<th>NAT RULE</th>
<th>TYPE</th>
<th>DETAILS/REASON</th>
<th>ORIGINAL IP</th>
<th>ORIGINAL PORT</th>
<th>TRANSLATED IP</th>
<th>TRANSLATED PROTOCOL/PORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow/443</td>
<td>DNAT</td>
<td>UI and API access from vCenter Operations Management Pack for vCenter Hyperic on vCenter Operations Manager analytics virtual machine to vCenter Hyperic server</td>
<td>vCloud Air public IP for vCenter Hyperic server</td>
<td>443</td>
<td>Private IP of vCenter Hyperic server in vCloud Air</td>
<td>TCP/443</td>
</tr>
<tr>
<td>Allow/443</td>
<td>SNAT</td>
<td>HTTP POST access to vCenter Operations Manager UI virtual machine from vCenter Hyperic server</td>
<td>Private IP of vCenter Hyperic server in vCloud Air</td>
<td>443</td>
<td>vCloud Air public IP for vCenter Hyperic server</td>
<td>TCP/443</td>
</tr>
</tbody>
</table>

Table 1. vCloud Air NAT Rules
Monitoring Hybrid Cloud Applications in VMware vCloud Air

### Table 2. Customer On-Premises NAT Rules

<table>
<thead>
<tr>
<th>NAT RULE</th>
<th>TYPE</th>
<th>DETAILS/REASON</th>
<th>ORIGINAL IP</th>
<th>ORIGINAL PORT</th>
<th>TRANSLATED IP</th>
<th>TRANSLATED PORT/PROTOCOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow/443</td>
<td>DNAT</td>
<td>HTTP POST access to vCenter Operations Manager UI virtual machine from vCenter Hyperic server</td>
<td>On-premises public Internet-facing IP address for vCenter Operations Manager UI virtual machine</td>
<td>443</td>
<td>Private IP of vCenter Operations Manager UI virtual machine</td>
<td>TCP/443</td>
</tr>
<tr>
<td>Allow/443</td>
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<td>UI and API access from vCenter Operations Management Pack for vCenter Hyperic on vCenter Operations Manager analytics virtual machine to vCenter Hyperic server</td>
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<td>443</td>
<td>On-premises public Internet-facing IP address for vCenter Operations Manager analytics virtual machine</td>
<td>TCP/443</td>
</tr>
</tbody>
</table>

### Firewall Rules

The firewall should always be **enabled** and the default action set to **deny**. The rules detailed in Table 3 should be configured on the edge gateway inside vCloud Air.

**NOTE:** The vCenter Operations Manager UI virtual machine should not be exposed to external public Internet traffic unless it is locked down to allow only the source address of the vCloud Air IP address. This ensures secure access from vCloud Air only.

<table>
<thead>
<tr>
<th>FIREWALL RULE</th>
<th>DETAILS/REASON</th>
<th>SOURCE</th>
<th>DESTINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow/443</td>
<td>For HTTPS API access on vCenter Hyperic</td>
<td>vCenter Operations Manager analytics virtual machine</td>
<td>vCloud Air public IP address for vCenter Hyperic server</td>
</tr>
<tr>
<td>Allow/443</td>
<td>For HTTPS access to UI virtual machine for posting HTTPS metric data</td>
<td>vCloud Air public IP address for vCenter Hyperic server</td>
<td>vCenter Operations Manager UI virtual machine</td>
</tr>
</tbody>
</table>

### Security Warnings with Solution Requirements

Based on the rules detailed in the previous sections, the security risk in this configuration is considered low, not requiring a VPN between the vCloud Air and on-premises sites. All traffic is encrypted inbound and outbound over HTTPS, using SSL over port 443.

The rules can also be locked down to the receiving IP address on either side of the destination, which helps provide an additional layer of safety in high-security environments. As always, any firewall or NAT configuration should be reviewed by corporate security team(s).

The way the vCenter Operations Management Pack for vCenter Hyperic “posts” data to vCenter Operations Manager exposes the vCenter Operations Manager UI virtual machine to the public Internet. However, the source and destination firewall rules on the corporate on-premises side and vCloud Air edge gateway side are locked down to specific public IP addresses to ensure that external access is not permitted from any source.
Deployment and Installation of the vCenter Hyperic Server on vCloud Air

This section describes the required steps for deploying the vCenter Hyperic appliance in a vCloud Air environment. The user performing these actions must have the proper roles and permissions to execute these tasks.

Requirements

The following files are needed to deploy vCenter Hyperic on vCloud Air. Use of the OVF and VMDK files rather than the OVA file for each appliance is recommended due to a change in the OVA packaging that can cause errors during the upload process to VMware vCloud Director®. Individual OVF, VMDK, and MF files can be obtained from the MyVMware Downloads page.

The following files are needed for deployment of the vCenter Hyperic server and database:

- vCenter-hyperic-DB-5.8.1-EE.vmdk
- vCenter-hyperic-DB-5.8.1-EE_OVF10.mf
- vCenter-hyperic-DB-5.8.1-EE_OVF10.ovf
- vCenter-hyperic-server-5.8.1-EE_OVF10.mf
- vCenter-hyperic-server-5.8.1-EE_OVF10.ovf
- vCenter-hyperic-server-5.8.1-EE.vmdk
- VMware-ovftool-3.5.0-1274719-win.x86_64.msi

Deploying the vCenter Hyperic Server Appliance on vCloud Air

1. Log in to vCloud Air—formerly named VMware vCloud® Hybrid Service™—and select the virtual data center where you want to deploy the vCenter Hyperic appliance.

2. Obtain the vCloud Director API URL by clicking the box, as shown in Figure 2. You must have the specific virtual data center that you are going to deploy the vCenter Hyperic appliances to via the OVFTOOL. This tool is part of the vSphere C# Client installer; optionally, you can obtain the OVFTOOL installer separately from MyVMware Downloads.

![Figure 2. vCloud Director API URL](image-url)
3. There are two OVF files you must upload to your cloud account. The first is the vCenter Hyperic server; the second is the database server. They can be uploaded in either order. For a successful upload to vCloud Air, you must place the OVF, MF, and VMDK files in the same source-upload directory.

4. Open a Windows command prompt and proceed to the following directory example or to where the OVF tool is installed.

The following are example commands for the vCenter Hyperic server and database:


5. The upload process will prompt for a username and password. Use your usual vCloud Air credentials.

6. The file will start to upload to the catalog on the specific vCloud Director organization. This might take a long time, depending on the speed of your Internet connection to the vCloud Air environment.

7. Log in to the back-end vCloud Director portal from the vCloud Air UI. You must access the portal page first by logging in to the vCloud Air portal and then clicking the vCloud Director link for proper token passing.

8. Proceed to access the Catalogs screen where you uploaded the vCenter Hyperic appliances.

9. Now that the appliances have been uploaded to vCloud Air, proceed to deploy each template by right-clicking the VMware vSphere vApp™ template and click add to my cloud.

10. A new window will appear that will walk you through the appliance deployment, asking for network properties and other settings. Most of the settings can be left at default because DHCP is usually enabled by default in a vApp network.

11. When completed, the vCenter Hyperic UI and database server will be deployed.

12. Power on each vApp from the Overview page.
Verify NTP Settings on the vCenter Hyperic Server

If vCenter Hyperic erroneously indicates that resources are unavailable, it might be because the system clocks on the agent and server hosts are out of sync. An offset of less than 1 minute is unlikely to pose problems; with a larger offset, problems might occur.

To solve an offset problem, make sure that NTP is configured on the agent and server hosts.

**NOTE:** It is important to verify that the vCenter Hyperic server running in vCloud Air is time synced with the on-premises vCenter Operations Manager server. If the offset between the system clocks is more than 1 minute, only availability metrics are collected during each collection cycle.

Deploy vCenter Hyperic Agents on vCloud Air Virtual Machines

Installation of the vCenter Hyperic agents on vCloud Air resources follows the same process as any other vCenter Hyperic agent installation. For details on installation and configuration, see the “Install and Configure the vCenter Hyperic Agent” section for Linux and Windows machines located on page 30 of the [vCenter Hyperic Installation and Configuration Guide](https://c368768.ssl.cf1.rackcdn.com/product_files/14184/original/vCenter_Operations_Management_Pack_for_vCenter_Hyperic_Installation_and_Configuration_Guide_V5.81193ee078bd10295a834942c56268.pdf).

vCenter Operations Management Pack for vCenter Hyperic

Install and Configure vCenter Operations Management Pack for vCenter Hyperic


When configuring the vCenter Hyperic adapter instance, it is important to enter the public IP addresses instead of the private IP addresses for the server URLs. For the vCenter Hyperic server URL field, see `https://<vCloud-Air-Public-IP>:443` and for the vCenter Operations Manager URL enter `https://<vCOps-UI-VM-Public-IP>`.

The vCenter Operations Management Pack for vCenter Hyperic is a hybrid adapter: It uses two different collection mechanisms to function and successfully collect data from vCenter Hyperic.

First, the adapter uses the vCenter Hyperic REST API to obtain resources, resource relationships and metric names, and attribute lists. Second, it uses vCenter Operations Manager HTTP POST to actually post time series data from the vCenter Hyperic server. Proper troubleshooting for any type of collection issue requires a thorough understanding of the collection flow as shown in Figures 8 and 9.

After the vCenter Hyperic agents have been successfully deployed and are collecting data inside vCenter Hyperic, data should be available in vCenter Operations Manager on premises.

Test Adapter Connectivity

The **Adapter Test** function inside vCenter Operations Manager performs a complete test to ensure connectivity to and from vCenter Operations Manager and vCenter Hyperic. Inside the custom UI of vCenter Operations Manager, perform an adapter test through the following process:

1. On the top toolbar, click Environment.
2. Click Configuration.
3. Click Adapter Instances.
4. Find the management pack for the vCenter Hyperic instance that was added for the vCenter Hyperic server located in vCloud Air.
5. Click the instance and click Edit in the top toolbar.
6. Click **TEST** to verify connectivity to vCenter Hyperic.

7. Notate any errors that occur. In most cases, failures to connect are due to firewall or NAT issues between on-premises and cloud sites. Verify all ports and that connectivity can be established between vCenter Operations Manager and vCenter Hyperic servers.

8. See the following screenshot example in Figure 3.

![Figure 3. Test Adapter Connectivity](image)

**Verify Resource Collection**

As explained in the previous section, the management pack for vCenter Hyperic is a hybrid adapter, so you must verify at two separate levels to ensure that collection is occurring properly and completely. Verify resource collection by performing the following process inside the custom UI:

1. On the top toolbar, click **ENVIRONMENT**.
2. Click **ENVIRONMENT OVERVIEW**.
3. On the left-hand panel, expand **Adapter Instances**.
4. Locate **MP for Hyperic** and expand the + sign.
5. The adapter instance will be located in the expanded + sign area.
6. After it has been expanded, you should see the name of the adapter instance and the amount of resources located inside parentheses.
7. If the number is (0), you are not collecting resources through the REST API on vCenter Hyperic.
8. If you have a number inside, such as (10), click this adapter instance name on the right-hand panel; you should see a populated list of resources in vCenter Hyperic.
9. See the following screenshot example in Figure 4.

![Figure 4. Verify Resource Collection](image)

**Verify Metric Data Collection**

In the second phase of data verification, confirm that actual metric data is being received by vCenter Operations Manager. Metric data is obtained via HTTP POST and is separate from the REST API calls. Continuing the process, follow these steps:

1. In the right-hand pane, find a platform resource: Windows or Linux virtual machine.
2. Click the resource for which you want to view details and metrics.
3. On the top toolbar, click **Show Details**.
4. On the next screen that appears, you should see the resource relationships for the object you selected.
5. In the bottom left-hand panel, under **Metric Selector**, expand the metrics that you want to view—for example, **CPU, Utilization, CPU0, Metric**.
6. In the right-hand view, select the metric plotted in the graph you want to see.
7. If no metrics are plotted or if you receive **no data**, the metric data is not being posted or collected correctly. Verify that the vCenter Hyperic server can communicate with the vCenter Operations Manager UI virtual machine and that the clocks are in sync on all servers.
8. See the following screenshot example in Figure 5.

![Figure 5. Verify Metric Data Collection](image)

**View Collector Logs**
When there are troubleshooting collection issues, the collector applies logs to the `$ALIVE_BASE/user/log/collector.log` file. All collection occurs via the analytics virtual machine; however, HTTP POST data is posted via the vCenter Operations Manager UI virtual machine, and there are limited log files available.

1. SSH to the analytics virtual machine.
2. View `$ALIVE_BASE/user/log/collector.log`.
3. SSH to the UI virtual machine.
4. View `$ALIVE_BASE/user/log/HTTPPostAdapter.log`.
5. Go to the end of the document; page through the log for errors on collection.
6. Look at the web.log file on the UI virtual machine; this will also assist with some errors, also located in `$ALIVE_BASE/user/log/web.log`.
7. SSH to the UI virtual machine.
8. View `$ALIVE_BASE/user/log/web.log`.
9. Go to the end of the document; page through the log for errors on collection.
10. Optionally, you can also view the logs in the custom UI by clicking on **Admin-Support-Logs**.
Adding vCenter Operations Management Pack for vCloud Air

This section introduces the vCenter Operations Management Pack for vCloud Air. This management pack includes an embedded adapter that collects metrics, change events, and resource topology information from your vCloud Air account and displays this information in your on-premises vCenter Operations Manager dashboard.

This management pack is an optional layer in the hybrid cloud monitoring architecture that leverages vCenter Hyperic as described in previous sections. You can run it together with vCenter Hyperic on vCloud Air, to collect both in-depth virtual machine-level performance metrics and vCenter Hyperic application-level metrics. You can also build relationships between these two components to give you more visibility into metrics affecting the overall health of an application.

The following screenshot in Figure 6 shows the SpringTrader application, along with the parent virtual machine in vCloud Air where the application is running. Beneath the application are component services that are obtained by vCenter Hyperic. You can “walk up and down” this health tree to see the metrics change and how the health affects the parent resources.

Figure 6. Application Topology
The following screenshot in Figure 7 shows the creation of a relationship with a master vCenter Hyperic component under the vCloud Air virtual machine.

Figure 7. Building Manual Relationships

vCenter Operations Management Pack for vCloud Air works with vCenter Operations Manager 5.8.x and 5.8.1. The management pack is available on VMware Solution Exchange: https://solutionexchange.vmware.com/store/products/management-pack-for-vcloud-hybrid-service#.U80D1_mSx8E.

Appendix 1: Collection Data Flow

Figure 8. Collection Data Flow
Appendix 2: Collection Workflow

Figure 9. Collection Workflow